FINAL REPORT

ELECTRONICS ARTICULATION WORKSHOP

Catonsville Community College
and
Baltimore County High Schools and
Vocational Technical Schools

August 15-19, 1977

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The funds for this workshop were provided by a grant from the State Board for Community Colleges. The Director of the Workshop was Joseph A. Scarlett, Director of Career Programs, and the Chairperson for the Workshop was William L. Roberts, Assistant Professor, Electronics Technology, Catonsville Community College.

August 19, 1977

The Workshop to develop an Electronics Articulation Agreement between Baltimore County Comprehensive High Schools, Vocational-Technical Schools, and the Catonsville Community College has agreed upon and recommends the implementation of the following policies and procedures contained in the appended report.

WORKSHOP PARTICIPANTS

FOR CATONSVILLE COMMUNITY COLLEGE

William L. Roberts

FOR THE BALTIMORE COUNTY HIGH SCHOOLS

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FOR THE BALTIMORE COUNTY VOCATIONAL-TECHNICAL SCHOOLS

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INTRODUCTION

Students completing curricula in comprehensive high schools and Vocational-Technical Schools often repeat the same related materials, experiences, and courses in college. In order to minimize this needless repetition and to address the problem of articulation between comprehensive high schools, Vocational-Technical Schools and the Catonsville Community College, this workshop was convened for the week of August 15 through August 19, 1977.

Representatives from three Vocational-Technical Schools - Southeastern, Eastern, and Western; two comprehensive high schools - Dulaney and Catonsville; and the Catonsville Community College participated in the workshop to develop a proposal for an integrated curriculum.

The workshop participants determined that students often repeat introductory material, experiences, and courses upon enrolling in an electronics college program. Although the Catonsville Community College has a credit-by-examination policy, by which the student may challenge many of the college courses for credit, many students are reluctant, for various reasons, to take advantage of this alternative.

The similarity of the electronics curricula ideally offers a basis for an articulation agreement and the presentation of an integrated program. By initiating an integrated program, a student would be aware that he or she could bypass the college course and still receive college credit by advanced placement through an earnest attempt for higher achievement on the high school level. This would provide incentives for the student to continue on and complete the degree requirements on the college level; an opportunity to broaden technical competency; to strive for excellence on the high school and Vocational-Technical School level, and even to encourage enrollment in both the high school and college electronics curricula.

Through the Articulation Program and the resulting newly developed channels of communication, the Catonsville Community College will gain additional insight as to how better serve the individual needs of the participating students.

This document represents the efforts of the workshop to ease the students transition from high school to college. Not only were the participants able to present concrete articulation proposals, but through working together got to know each other and gained valuable insight into the programs conducted at each institution. A spirit of continuing cooperation and mutual respect has developed from the workshop, which will promote better communications between the comprehensive high schools, the Vocational-Technical Schools, and the Catonsville Community College.

PROJECT OBJECTIVES

The workshop participants agreed upon seven objectives for the project.

1. Examine each institution's course objectives and learning sequences in the electronic areas.
2. Compare the course objectives and learning experiences.
3. Recommend changes, if necessary, to obtain uniformity in course objectives and learning experiences.
4. Develop an articulation agreement.
5. Develop implementation procedures at the participating institutions.
6. Develop follow-up procedures to evaluate the effectiveness of the articulation agreement.
7. Develop articulation credit examination for articulated courses.

Articulation Agreement

Baltimore County High Schools and Vocational Technical Schools to Catonsville Community College

Catonsville Community College has agreed to grant college credit to students completing the Electronics Program at a Baltimore County High School or Vocational Technical School for the following courses:

ELE 101	Fundamentals of Electronics I	4 credits
ELE 102	Fundamentals of Electronics II	4 credits

The following criteria must be met in order for the students to receive the credits:

1. Students shall complete an equivalent two year articulated Electronics Program at a Baltimore County High School or Vocational Technical School with an average grade of B or better.

2. Credit for the articulated courses shall be awarded upon the successful completion of the articulation credit examination with a grade of 70% or better. A letter of certification from the electronics instructor and verified by the school principal will then be issued.

3. Request by the student for the credit must be made within two years after graduation from the High School or Vocational-Technical School.

4. The letter of certification shall mean that the student has satisfied the requirements of the articulated electronics program at the High School or Vocational-Technical School. This includes the following articulated courses, areas and laboratory experiences.

Articulated Courses	Areas	Laboratory Experience
ELE 101	Voltage and Current	Voltage/Current Relationships
	Scientific Notation	Resistance in Series
	Resistance in Series	Resistance in Parallel
	Resistance in Parallel	Resistance in Series Parallel
	Resistance in Series Parallel	Electrical Power in "R"
	Electrical Power in "R"	Capacitance
	Capacitance	Inductance
	Inductance	The Sinusoidal Waveform
	The Sinusoidal Waveform	Inductive Reactance
	Opposition in AC Circuits	Capacitive Reactance
	RC Circuit Response	Impedance
	RL Circuit Response	RC Circuit Response
	Vector Algebra	RL Circuit Response
		RCL and Resonance
	RCL &Resonance	Power in AC Circuits
	Power in AC Circuits	

Articulated Courses	Areas	Laboratory Experience
ELE 102	Resonance	Resonance
	Filters	Filters
	Transformers	
	Power Supplies	Power Supplies
	Voltage Multipliers	Voltage Multipliers
	Voltage Regulation	Voltage Regulation
	Basic Amplification	
	Voltage Amps	Voltage Amps
	Feedback Amplifiers	Feedback Amplifiers
	F.E.T.'s	
	Frequence Response	Frequency Response
	Power Amplifiers	Power Amplifiers
	Multistage Amplifiers	
	Oscillators	Oscillators
	Communication Systems	Communication Systems

IMPLEMENTATION PROCEDURE

High School and Vocational-Technical Schools Implementation Procedures with Catonsville Community College

I. Implementation Procedure at the Community College

A. To implement the articulation agreement at the community college, the following procedure is proposed:

1. The College will set up Admissions Office and Record Office procedures to handle students that are certified for credit from High School/Vocational Technical schools. (See Part I-B below for sample procedure.)

2. Program coordinators at the College will interview the students and maintain files for follow-up of students receiving the certification for credit.

B. Suggested procedure for community college admission of student with letter of certification.

1. When applying for admission to CCC, the student will present the appropriate letter of certification along with the application for admission.

2. The records office at the college will grant a grade of "S" for the course(s) certified. The grade(s) will be recorded on the student's record with the notation "Credit Per Articulation Agreement," and the letter of certification retained in the student's file.

3. The college records office will forward a copy of the student's record with the course credit awarded to the Program Coordinator. The Program Coordinator will notify the high school/Vocational-Technical School instructor.

4. The student may register for the next course in the curriculum sequence.

II. Implementation Procedure at the High School/Vocational-Technical Schools.

A. To implement the articulation agreement at the High School/Vocational-Technical schools, the following procedure is proposed:

1. The schools will communicate the details of agreements to the Coordinator of Industrial Arts and Vocational Education, principals, teaching faculty, guidance personnel, work-study coordinators and students.

2. The schools will develop methods of publicizing the agreements in order to encourage students to take advantage of this opportunity.

3. The schools will develop a procedure for certifying students for credit in the course or courses for which he or she is eligible for articulation credit. The original of this letter will be given to the student, a copy will be mailed to the CCC Electronics Department Coordinator. (See sample letter of certification

III. Articulation Agreement Maintenance and Review

A. The Articulation Agreement shall be reviewed at least every three years by representatives of the Industrial Arts and Vocational Technical Programs and the CCC Electronics Department.

B. Revisions of applicable course syllabi at any of the participating schools or CCC should be sent to the applicable instructors.

Sample Letter of Articulation Certification

High School/Vocational-Technical School

TO: CCC _____ Representative/Coordinator

FROM: Recommending School _____

Re: Student Name: Articulated Credit Certification

This is to certify that _____ has successfully
Name
completed the _____ Program as of _____. Based upon
Certification Date
the articulation agreement it is recommended that credit be given for the following courses: (Enrollment must occur within two years of the certification date.)

(List applicable college course(s):

_____

_____

_____

The undersigned certify that the student has met the criteria as defined in Part II of the Articulation Agreement for courses produced by representatives of Baltimore County High Schools and Vocational-Technical Schools and Catonsville Community College dated _____ and has at least a B average.

_____
Instructor

_____
Principal

(FOR COLLEGE USE ONLY)

Interview with representative of Catonsville Community College _____ Department

Date _____

_____
Department Representative

Verification of Credit

_____
Division Head

FOLLOW-UP PROCEDURE

In order to provide for objective evaluation of the articulation agreement, the following procedures were agreed upon by the workshop participants to develop a greater understanding of eaoh institution's progress and allow for a more precise evaluation of students accomplishment:

1. The Program Coordinator in the Electronics Department at the College will maintain records of students certified for articulated credit.

2. Progress of students receiving credit will be monitored annually until completion of the program or termination.

3. Progress of each student will be provided annually to the recommending teacher.

4. At the end of two (2) years, the articulation agreement will be evaluated and thereafter on an annual basis, to include the following for participating students:

   a. Number of students who complete the degree or certification program.

   b. Number of students who withdraw from the program.

   c. Number of high school and Vocational-Technical students who select the Articulation Program rather than the Catonsville Community College credit-by-examination.

   d. Percentage of electronics Articulation Program students who find related employment and/or continue educational goals.

   e. A copy of the annual report will be sent to the Coordinator of Industrial Arts and Vocational Education of Baltimore County, the Catonsville Community College Division Head, and Director of Career Programs.

5. At the end of three years, the Coordinator of Electronics at Catonsville Community College will sponsor a meeting to re-evaluate the Articulation Agreement.

(SAMPLE FORM)

STUDENT EVALUATION

Name _____

Semester: Fall _____ Spring _____ Summer _____ Year _____

High School/Vocational Technical School Attended: _____

Credit Per Articulation Agreement:

ELE 101 _____

ELE 102 _____

College Major: _____

Electronics Courses Completed

Course #	Course Title	Grade
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Overall Q.P.A. _____

Comments:

SUMMARY

During the entire workshop on Articulation of Electronics Technology, an atmosphere of mutual respect and dedication to purpose developed. The similarity of the electronics courses in use at the participating institutions, the need to minimize needless repetition, and the need to encourage students to further pursue their electronics training provided emphasis for early concurrence on an articulation agreement.

However, the articulation agreement, its policies and procedures, will be of little or no value unless ultimately the electronic students, and potential students are properly informed of its existence and understand its full significance. The participants of this workshop wholeheartedly encourage the Baltimore County School System, in particular the individual schools, to give proper emphasis when publicizing the articulation agreement.

The following were viewed as significant accomplishments of the workshop:

Providing the high schcol instructors with a first hand knowledge of the community college program.

Providing the college staff with first hand knowledge of the high school/vocational school programs.

Identification of specific skill and knowledge factors necessary for successful completion of college programs.

Establishment of an integrated program to encourage continued technical education.

Construction of an evaluation instrument.

The participants also realize the importance of the follow-up procedure, as well as the necessity for a conference to re-evaluate the articulation agreement in the near future to ensure the success of the agreement.

Hopefully, because of the renewed cooperation, understanding and respect resulting in the initial success of this workshop, other disciplines will be encouraged to undertake a similar endeavor. Indeed this has been a most worthwhile and profitable experience for all concerned.

APPENDICES

COURSE OUTLINES

AND OBJECTIVES

OBJECTIVES AND COURSE OUTLINES

CATONSVILLE COMMUNITY COLLEGE

CATONSVILLE COMMUNITY COLLEGE
Catonsville, Maryland 21228

Math/Engineering Division

1. Course Title:

Fundamentals of Electronics I ELE 101 (4:3,3)

2. Textbooks:

Direct and Alternating Current
Second Edition - Oppenheimer, Hess, Borchers
McGraw-Hill, 1972

3. Course Objectives:

See attachment #1

4. Sequence of topics and time allocations:

See attachment #2

5. Teaching Procedures and Classroom activities:

Lecture - discussion - demonstration and student participation

6. Grading Practice: See teacher of the course for this information.

50% lecture
50% lab experience

7. Attendance Policy:

See attachment #3

Attachment #1
ELE-101 COURSE OBJECTIVES

1. The student will demonstrate an understanding in the areas of measurement. The student will calculate basic quantities using scientific notation and slidenule.

2. The student will demonstrate an understanding in the area of atomic structure and electrostatics. The student will calculate basic formulas of charge.

3. The student will demonstrate an understanding in electrical units of measurement such as charge, voltage, current and resistance. The student will calculate these quanities and their relationships for DC type circuits.

4. The student will demonstrate an understanding in the area of Ohm's Law. To calculate the relationships of Ohm's law circuits, such as series, parallel and complex DC circuits.

5. The student will demonstrate an understanding in the area of AC measurements. The student will calculate average, effective voltage and current. The student will also calculate frequency of AC waveforms.

6. The student will demonstrate an understanding in the theory of capacitance both DC and AC circuits. The student will calculate several physical and electrical properties of capacitance.

7. The student will demonstrate an understanding in Electromagnetic induction DC and AV circuits. The student will calculate several physical and electrical properties of inductance.

8. The student will demonstrate an understanding in R-L-C circuit analysis AC circuits. The student will analysis using trigomometry and the V-operator to solve circuit problems. Problems will include series and parallel circuits.

9. The student will demonstrate an understanding in theory of series and parallel resonant circuits. The student will be able to calculate all conditions of resonant circuits.

The Following Objectives Pertain to Lab

1. The student will demonstrate his ability to perform with VOM, VYVM, AF and RF signal generator, frequency counter and Oscilloscope basic measurements of electrical components and also their relationships discuss in lecture class.

2. The student will verify with test equipment laws and relationships discuss in lecture class such as:

A) Ohm's Law - series, parallel, complex
B) Capacitance - DC and AC
C) Inductance - DC and AC
D) Resonant circuits - series and parallel
E) AC waveform measurements

SEQUENCE OF TOPICS AND TIME ALLOCATIONS

I. Fundamental, Quantities and Concepts — 1 week

- A. Length, mass and time
- B. Structure of the atom
- C. Charge
- D. Coulombs law

II. Physical and Electrical Units — 1 week

- A. Length, mass and time
- B. Work, energy and power
- C. Electric circuit
- D. Voltage, current and resistance

III. Chin's Law and Power — 3 weeks

- A. Ohm's law
- B. Series circuit DC
- C. Parallel circuit DC
- D. Complex circuit DC
- E. Power

IV. Capacitance — 1 week

- A. Physical
- B. Electrical
- C. DC - time constants
- D. AC - phase
- E. Reactance

V. Inductance — 1 week

- A. Physical
- B. Electrical
- C. DC - time constant
- D. Phase
- E. Reactance

VI. RLC - Circuit Analysis — 3 weeks

- A. Pure resistance circuit
- B. Pure inductance circuit
- C. Pure capacitance circuit
- D. J operator

VII. Series and Parallel AC Circuits — 3 weeks

A. Impedance
B. Series AC circuit
C. Parallel AC circuit
D. Power in AC Circuit

VIII. Series and Parallel Resonant Circuits — 2 weeks

A. Series resonance
B. BW and Q
C. Parallel resonance
D. BW and Q

CATONSVILLE COMMUNITY COLLEGE
Catonsville, Maryland 21228

Math/Engineering Division

1. Course Title:

Fundamentals of Electronics II
ELE-102 (4:3,3)

2. Textbooks:

Communications Electronics Circuits, Second Edition
J. J. DeFrance, Rinehart Press, 1972

3. Course Objectives:

See attachment #1

4. Sequence of topics and time allocations:

See attachment #2

5. Teaching Procedures and Classroom activities:

Lecture - discussion - demonstration and student participation

6. Grading Practice: See teacher of the course for this information.

50% lecture
50% lab experience

7. Attendance Policy:

See attachment #3

Attachment #1
Course Objectives

1. The student will demonstrate an understanding of the resonant circuits by problem solving circuit analysis, and by measurements made by lab performances.

2. The student will demonstrate by problem solving and circuit analysis the understanding of basic coupling circuit. The student will also perform tuning techniques to support theory.

3. The student will demonstrate by problem solving and basic circuit measurements of RF voltage amplifiers, the understanding of voltage amplification.

4. The student will demonstrate by problem solving and basic circuit measurements of RF Power Amplifiers, the understanding of Power amplification.

5. The student will demonstrate an understanding of RF Oscillator circuits by drawing schematics and performing frequency measurements on RF Oscillators.

6. The student will demonstrate an understanding of AM, SSB, FM, modulation techniques by problem solving and performing with oscilloscope various waveform measurements with these modulation techniques.

7. The student will demonstrate the understanding of AM SSB, FM, receiving techniques, by problem solving and performing various waveform measurements and also alignment practices.

Attachment #1
Lab Objectives

The student shall demonstrate an understanding of the following course content by lab performance.

1. The fundamentals of resonance, series and parallel, circuit Q, bandwidth, and applications of resonance.

2. Filter circuits including high pass, low pass, and bandpass characteristics.

3. Basic electronic power supplies, filtering, voltage division, and regulation.

4. The fundamentals of basic circuitry including amplifiers, oscillators, detectors, and mixers.

5. The fundamentals of modulation and modulators, transmitters, and transmission of electromagnetic energy.

6. Receiver analysis covering fidelity, selectivity, distortion, and alignment procedures.

Attachment #2
Sequence of Topics and Time Allocations

I. Resonance — 1 week

A. Series Resonance
   1. Circuit Q
   2. LC product
   3. Voltage ratios
B. Parallel Resonance
   1. Currents in parallel
C. Uses of Resonant Circuits

II. Basic Electronic Circuits — 1 week

A. Filter Action
   1. Types of filters
B. Band Pass Filters
C. Impedance Matching

III. R-F Voltage Amplifiers — 1 week

A. Impedance-Coupled R-F Amplifiers
   1. Gain, bandwidth, multistage response
   2. Stagger tuning
B. Double-Tuned Transformer-Coupled R-F Amplifiers
   1. Bandwidth, gain
C. High Frequency Circuits

IV. R-F Power Amplifiers — 2 weeks

A. Class C Amplifiers
   1. Voltage and current relations
   2. Grid bias
   3. Plate power supply
   4. Parallel operation
   5. Push-pull operation
B. Neutralization in Class C Amplifiers
   1. Techniques
   2. Circuits
C. Class B Linear Amplifier

V. R-F Oscillators — 1 week

A. General Considerations
   1. Tank circuit action
   2. L-C circuit analysis

B. Basic Oscillator Circuits
   1. Armstrong
   2. Grid leak bias
   3. Shunt and series fed bias
   4. Hartley, Colpitts oscillator
   5. Stability of oscillators

C. Crystal Oscillators
   1. Crystal cuts
   2. Temperature effort

VI. Amplitude Modulation — 2 weeks

A. Analysis of A.M. Waves
   1. Effect of modulating signal
   2. % modulation
   3. Power in A.M. wave
   4. Sidebands

B. Plate Modulation
   1. Basic principles

C. Basic Transmitters

VII. Demodulation of A.M. Waves — 1 week

A. Basic Principles
   1. Diode detector
      a. Basic circuit action

B. Other types of A.M. Detectors
   1. Grid-leak, plate

VIII. A.M. Receivers — 2 weeks

A. Receiver Comparison Factors
   1. Sensitivity, selectivity, fidelity, noise ratio

B. Superheterodyne Receivers

C. Receiver Alignment

IX. SSB Transmission and Reception — 2 weeks

A. Filter and Phasing Methods
B. Balance Modulators
C. Product Detectors
D. BFO
E. Carrier Reinsertion

X. FM - Transmission and Reception — 2 weeks

A. FM Waveforms
B. Reactance Modulator
C. Limiters
D. Discuminators
E. Ratio Detector

COURSE OUTLINES AND OBJECTIVES

BALTIMORE COUNTY HIGH SCHOOLS AND

VOCATIONAL-TECHNICAL SCHOOLS

Program: POWER TECHNOLOGY

Course Title: INTRODUCTORY ELECTRONICS

County Course No.: 7980 5 periods/week 1 credit

Number of weeks: 36

Course Description:

A beginning course in electronics which deals with basic electronic principles and applications. Students participating in this course conduct experiments and construct projects related to electrical measurement, circuit theory and tube and solid state devices.

Activities include demonstrations, experiments and the construction of several take-home projects.

Prerequisities and other notes:

Elective for grades 9, 10, 11, and 12

COURSE OUTLINE: Electronics I

CONTENT TOPICS	PROGRAM GOALS
I. Orientation	Familiarize students with course goals, objectives and requirements and the location of laboratory facilities.
II. Fundamental Concepts	Acquaint students with basic physics; basic electrical terms, and electronic construction techniques.
III. Sources of Electrical Power	Familiarize students with the means of creating potential differences in order that they will be able to select the appropriate sources of electrical power.
IV. General Safety	Develop student understanding of the safety precautions that must be observed when working with electronic devices in order to insure individual safety.
V. Use and Care of Measurement Instruments	Familiarize students with the function and use of basic test instruments and the precautions required in order to conduct a circuit analysis.
VI. Resistors	Develop student understanding of the effects of resistance and the materials and components used to create resistance in order that they will be able to select the proper circuit resistive components.
VII. Basic Circuits	Enable students to recognize the basic difference in circuit arrangements and to analyze the operational characteristics of each in order that they will be able to construct and maintain simple circuits.
VIII. Magnetism, Electro-magnetism	Acquaint students with the theories of magnetism and their applications to electrical circuits.

COURSE OUTLINE: Electronics I

CONTENT TOPICS	PROGRAM GOALS
IX. Inductors	Develop student understanding of inductor functions and the ability to identify the factors which determine inductor value, ratings and effects on circuit operation.
X. Transformers	Enable students to select the proper transformer and utilize it in a specific circuit.
XI. Capacitors	Develop student understanding of capacitor functions and the factors that determine capacitor values, ratings and applications in circuit operation.
XII. Tubes/Solid State Devices	Familiarize students with the basic operations, limitations and ratings of vacuum tubes and solid state devices and their application in the control, amplification and rectification of electrical energy.

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics I

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
I. Orientation	The student will:		
A. Laboratory Procedures			
B. Program Goals and Objectives	become aware of the goals, objectives and requirements of the course.		
C. Laboratory Tour	become familiar with the location of the laboratory facilities and the location of safety equipment.	Locate on a floor plan all safety devices and physical features of the laboratory.	
II. Fundamental Concepts			
A. Atomic Structure 1. Conductors 2. Insulators 3. Semiconductors	be able to differentiate between types of conductors and insulators.	Perform experiments using laboratory manuals and/or available equipment.	D-1-1
B. Basic Terms and Prefixes 1. Basic Circuit 2. Coulomb 3. Ampere 4. Volt 5. OHM 6. MHO 7. Watt	be able to define and apply various units of electrical measurement.		
C. Construction Techniques	be able to properly solder electrical connections.	Perform a practice soldering exercise. Participate in review.	D-1-2

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics I

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
C. Construction Techniques		Take a test related to fundamental concepts.	D-1-3
		Begin Construction Project 1	D-1-4, 5, 6
III. Sources of Electrical Power	The student will:		
A. Direct Current 1. Friction 2. Pressure 3. Heat 4. Light 5. Magnetism 6. Chemical action	be able to identify and explain the various types and sources of electrical potential.	Perform voltaic cell experiment using laboratory manual, or related improvised experiment.	D-1-7
B. Alternating Current 1. Alternator 2. Oscillator a. P b. P-P c. RMS d. Average e. Frequency	be able to explain the differences between and the uses of AC and DC voltage. be able to identify the various mathematical values of AC.	Perform oscilloscope experiment using audio generator. Participate in a review of sources of electrical power. Take a test related to sources of electrical power.	D-1-8 D-1-9
IV. General Safety			
A. Shock hazards	demonstrate proficiency in safety and emergency procedures by passing a safety examination.	Become familiar with safety and protection devices. Understand emergency and evacuation procedures. Perform safety-related experiment.	
B. Laboratory Familiarization		Take and pass a safety test (to be filed by the teacher).	D-1-10

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics I

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
		Project 1 completed	D-1-11
V. Proper Use and Care of Measuring Instruments	The student will:		
A. Ohmmeter B. Voltmeter C. Ammeter D. Wattmeter E. Watt-hour meter F. VOM G. VTVM	be able to demonstrate the ability to properly utilize test instruments.	Select, set up, adjust, connect, and read the appropriate meters for measuring various quantities in electrical circuits. (With instructor's approval). Perform experiments related to ohmmeter, voltmeter, and ammeter utilization. Participate in a review on the use and care of measuring instruments.	D-1-12
		Take a test related to the use and care of measuring instruments.	D-1-13
VI. Resistors	The student will:		
A. Safety B. OHM's Law	be able to select and utilize the appropriate resistor in a selected circuit.	Select and properly install resistors based on an understanding of ratings and the several methods of indicating values	D-1-14
C. Color Code D. Tolerance E. Watt's Law (power)	be able to test, calculate, install, and determine the effects of resistance in any given circuit.	Perform resistor experiments. Participate in a review of resistors.	
		Take a test related to resistors	D-1-15

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics I

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
VI. Resistors (Cont'd)	The student will:		
F. Kinds/types			
G. Applications			
H. Defects			
VII. Basic Circuits			
A. Safety	be able to recognize and identify series, parallel and complex circuits.	Recognize and construct basic series, parallel, and complex circuits utilizing resistive elements from schematics.	
B. Series	be able to construct, test, and analyze series, parallel, and complex circuits.	Perform experiments to analyze and test series, parallel, and complex circuits with respect to current, voltage, and resistance.	D-1-16
1. Kirchoff's Law			
C. Parallel	be able to detect, locate, and correct defects in the three major circuits.		
D. Complex	be able to select the proper circuit for a given need.		
E. Schematics and Pictorials		Take quizzes related to basic circuits.	D-1-17
		Participate in a review on basic circuits.	
		Take a test related to basic circuits	D-1-18

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics I

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
VII. Basic Circuits (Cont'd)		Begin Project 2	D-1-19, 20, 21
VIII. Magnetism, Electromagnetism	The student will:		
A. Creation	be able to understand and explain the relationship between the laws of magnetism and the laws of electricity.	Perform experiments related to the basic laws of magnetism and electromagnetism.	D-1-22
B. Uses	be able to identify the devices that utilize electromagnetic energy.		
C. Control		Take quizzes related to magnetism and electromagnetism.	D-1-23
		Participate in a review on magnetism and electromagnetism.	D-1-24
IX. Inductors			
A. Safety	be able to select and utilize the appropriate inductor in a selected circuit.	Select and properly install inductors based on an understanding of ratings and the several methods of indicating values.	
B. Self inductance C.E.M.F.	be able to test, install, and determine the effects of inductors in any given circuit.	Perform experiments related to inductors.	D-1-25

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics I

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
IX. Inductors (Cont'd.)	The student will:		
C. Units of measure/ prefixes		Participate in a review related to inductors	
D. Kinds/types			
E. Applications 1. DC 2. AC			
F. Defects/testing		Take a test related to inductors.	D-1-26
G. Circuits 1. Series 2. Parallel 3. Complex			
H. RL time constant			
I. Reactance			
J. Impedence		Complete Project 2	D-1-27

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics I

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
X. Transformers	The student will:		
A. Safety	be able to select and utilize the appropriate transformer in a selected circuit.	Select and properly install transformers based on an understanding of ratings and the several methods of indicating value.	
B. Mutual inductance	be able to test, install, and determine the effects of a transformer in any given circuit.	Perform experiments related to transformers.	D-1-28
C. Kinds and uses			
D. Ratings/turns ratio			
E. Defects/testing		Take a test on transformers.	D-1-29
XI. Capacitors			
A. Safety	be able to select and utilize the proper capacitor in a selected circuit.	Select and properly install capacitors based on an understanding of ratings and the several methods of indicating values.	
B. Units of measure/ prefixes	be able to test, install, and determine the effects of capacitance in a selected circuit.	Perform experiments related to capacitors.	D-1-30
C. Kinds/types			

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics I

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
XI. Capacitors (Cont'd.)	The student will:		
D. Applications 1. DC 2. AC		Participate in review related to capacitors.	
E. Defects/testing		Take a test related to capacitors	D-1-31
F. Circuits 1. Series 2. Parallel 3. Complex			
G. RC time constant			
H. Reactance			
I. Impedence			
		Begin Construction of Project 3	D-1-32, 33, 34, 35, 36, 37
XII. Tubes/Solid State Devices			
A. Safety	be able to test a vacuum tube for proper operation.	Test and analyze diode and triode vacuum tubes for operational characteristics, functions, and defects.	
B. Diodes 1. Construction 2. Rating 3. Operation	be able to assemble a vacuum tube from a schematic.	Perform an experiment using tube devices.	D-1-38

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics I

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
XII. Tubes/Solid State Devices (Cont'd.) 4. Types/uses a. Power supplies b. Detection 5. Statics 6. Dynamic load line 7. Defects/testing	The student will:		
C. Triode 1. Construction a. Cathode b. Grid c. Anode 2. Operation 3. Types/uses a. Amplifier 1) Current 2) Voltage 4. Static 5. Dynamic 6. Defects/testing	be able to determine the basic operation of vacuum tube circuits.	Use appropriate instruments to measure and analyze the operation of the constructed project.	D-1-39
D. Tetrode			
E. Pentode			
F. Transistors 1. Types a. PNP b. NPN	be able to test a solid state device for its proper operation using resistance and voltage measurements.	Test and analyze solid state devices for their operational characteristics, functions, and defects.	

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics I

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
XII. Tubes/Solid State Devices (Cont'd.) 2. Uses 3. Operation 4. Characteristics a. Static b. Dynamic 5. Defects/testing	The student will:	Participate in a review related to tubes and solid state devices. Take a test related to tubes and solid state devices.	D-1-40

Program: POWER TECHNOLOGY

Course Title: ADVANCED ELECTRONICS

County Course No.: 7970 5 periods/week 1 credit

Number of weeks 36

Course Description:

Advanced Electronics is designed to provide the student with an opportunity to further develop understandings of the concepts presented in Introductory Electronics. In addition, the student will conduct experiments and construct take-home projects based on a study of the principles and operation of modern amplifiers and receivers.

Prerequisites and other notes: Introductory Electronics

Preference given to 11th grade students.

I. COURSE OUTLINE: Electronics II

CONTENT TOPICS	PROGRAM GOALS
I. Orientation	Familiarize students with course goals, objectives, and requirements and the location of laboratory facilities.
II. Review	Assess student understanding of basic electronic concepts presented in Electronics I.
III. Fundamentals of Radio Receivers	Develop student understanding of the fundamentals of radio receiver concepts and construction.
IV. Tubes	Review and further develop student understanding of vacuum tubes.
V. Solid-State Devices	Review and further develop student understanding of solid-state devices.
VI. Amplifiers	Familiarize students with concepts related to various types of amplifiers.
VII. Speakers	Develop student understanding of speaker characteristics and applications.
VIII. Microphones	Acquaint students with microphone characteristics and applications.
IX. Oscillators	Develop student ability to identify the kinds and types of oscillators and to understand the fundamental principles of oscillators.
X. Modulation	Develop student understanding of the principles of modulation.
XI. Demodulation	Develop student understanding of the principles of demodulation.
XII. AVC/AGC Circuits	Familiarize students with the purposes and operation of typical AVC/AGC circuitry.
XIII. I. F. Amplifier	Acquaint students with the characteristics of the I. F. amplifier.

I. COURSE OUTLINE: Electronics II

CONTENT TOPICS	PROGRAM GOALS
XIV. Converter	Develop student understanding of converters and their application to heterodyning.
XV. Antennas	Familiarize students with antenna fundamentals.
XVI. Wave Propagation	Acquaint students with the fundamentals of wave propagation.
XVII. Consumer Knowledge	Familiarize students with various electronic components, the methods of rating components and their applications in everyday use.

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
I. Orientation	The student will:		
A. Laboratory Procedures			
B. Program Goals and Objectives	become aware of the goals, objectives and requirements of the course.		
C. Laboratory Tour	become familiar with the location of the laboratory facilities and the location of safety equipment.	Locate on a floor plan all safety devices and physical features of the laboratory.	
II. Review			
A. Resistors	review the terminology, components, and instruments that were studied in Electronics I	Participate in a review of Electronics I content topics.	
B. Capacitors			
C. Inductors			
D. Transformers			
E. Tubes - Semiconductors			
F. Circuits			
G. Meters - Instruments	Participate in a class review of electronics laboratory safety practices.	Take a test related to Electronics I content topic review.	D-2-1
H. Safety		Begin construction of Project 1 by preparing the box and box top	D-2, -3, -4, -5, -6

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
III. Fundamentals of Radio Receivers	The student will:		
A. AM	become familiar with the basic circuitry used in AM and FM receivers.	Participate in class discussions related to block diagrams of AM and FM receivers.	
B. FM 1. Monaural 2. Stereo 3. Quadraphonic		Participate in a review of AM and FM receiver block diagrams Take a test related to AM and FM receiver fundamentals.	D-2-7
		Layout and etch the printed circuit board for Project 1.	
IV. Tubes			
A. Types	be able to identify various types of tubes from circuit applications.	Perform laboratory experiments involving static/dynamic characteristics.	D-2-8
B. Terminology			
C. Construction	be able to determine tube operating points on various load lines.	Participate in a review of tube characteristics.	
D. Operation		Take a test related to tube characteristics.	D-2-9
E. Static/Dynamic Characteristics	be able to define tube characteristics and apply them in a simple circuit.	Mount all Project 1 components and test resistors, capacitors and speaker for proper operation.	
F. Bias			
G. Lead Line	be able to identify various types of bias		

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
V. Solid-State Devices	The student will:		
A. Types B. Terminology	be able to identify various types of solid state devices from circuit applications.	Perform laboratory experiments involving transistor static/dynamic characteristics, bias and load line.	D-2-10
C. Construction 1. Diode 2. Transistor 3. SCR	be able to explain diode operation		
D. Operation 1. Diode 2. Transistor 3. SCR	be able to determine transistor operating points on various load lines.		
E. Static/Dynamic Characteristics	be able to define solid state device characteristics and apply them in a circuit.	Participate in a review of solid-state devices.	
		Take a test related to solid-state devices.	D-2-11
		Test Project 1 transistors with VTVM before mounting on printed circuit board.	
		Perform circuit resistance checks on Project 1 transistors using a VTVM.	

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
VII. Speakers	The student will:		
A. Shapes B. Sizes C. Ratings	be able to identify speakers according to shape, size and ratings.	Observe demonstrations related to speaker ratings, impedance, and cross-over networks. The effects of various enclosures may also be observed.	
D. Operation	be able to properly impedance match speaker to amplifier		
E. Matching to Amplifier F. Cross-over Network	be able to identify the uses of cross-over networks and the purpose of enclosures.		
G. Enclosures			
VIII. Microphones			
A. Types B. Ratings	be able to identify microphones according to types and ratings.	Observe demonstrations related to microphone types, ratings and matching.	
C. Matching to Amplifier	be able to properly match a microphone to an amplifier.	Participate in a review of speakers and microphones. Take a test related to speakers and microphones.	D-2-15

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
IX. Oscillators	**The student will:**		
A. Definition	be able to define oscillators by type and method of operation.	Perform oscillator experiments using available equipment.	D-2-16
B. Types 1. Armstrong 2. Hartley 3. Colpitts 4. Crystal	be able to identify typical uses of each type	Participate in a review of oscillators.	
C. Methods of Coupling	be able to define purpose and methods of coupling.	Take a test related to oscillators.	D-2-17
X. Modulation			
A. Definition	be able to define and identify an AM and FM wave envelope and determine percentage of modulation power.	Perform experiments on AM modulation observing the characteristics of the wave envelope.	
B. Types 1. AM 2. FM			
C. Principles of AM Modulation 1. Keying 2. CW Transmitters 3. Wave Envelope 4. Percentage of Modulation 5. Power and Sideband	be able to identify typical uses of various modulation methods.		

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
X. Modulation (Cont'd.) D. Methods of Modulation 1. Plate 2. Grid 3. Cathode E. Principles of FM Modulation 1. Wave Envelope 2. Percentage of Modulation 3. Power and Sidebands		Participate in a review of modulation. Take a test related in modulation principles and methods. Prepare box and top for Project 2	 D-2-19 D-2-20, 21, 22, 23

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
XI. Demodulation	The student will:		
A. Definition	be able to define demodulation.		—
B. Principles of AM Demodulation	be able to define operation and methods of AM demodulation.	Perform experiments related to AM demodulation.	D-2-24
C. Methods 1. Diode 2. Class C Amp.			
D. Principles of FM Demodulation		Make printed circuit board for Project 2.	
1. Purposes of limiter 2. Purposes of discriminator 3. Common circuit arrangements		Participate in class discussion of block diagram of FM demodulation.	
		Participate in review of AM and FM demodulation.	
		Take a test related to AM and FM demodulation.	D-2-25

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
XII. AVC/AGC Circuits	The student will:		
A. Purpose B. Method of Operation C. Typical Circuit Arrangement	be able to identify and explain the operation of typical AVC/AGC circuits.	Participate in class discussions related to AVC/AGC circuits and their relationship to other circuits. Mount and test Project 2 detector section on printed circuit board using Project 1 amplifier.	✓
XIII. IF Amplifier			
A. Definition B. Purpose C. Method of Operation D. Circuits 1. Untuned 2. Tuned (Resonance) a. Series and Parallel b. "Q" and Bandwidth c. Stagger Tuning	be able to identify, define and explain the operation of IF circuits. be able to differentiate between tuned and untuned circuits. be able to determine point of resonance and calculate "Q" and bandwidth.	Perform experiments related to the IF amplifier. Install output IF and associated components on Project 2 printed circuit board. Test and align Project 2 output IF circuit. Install and test interstage and first IF on Project 2 printed circuit board. Participate in a review of IF amplifiers. Take a test related to IF amplifiers.	D-2-26 D-2-27

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
XIV. Converter (First Detector)	The student will:		
A. Definition B. Purpose	be able to identify and explain the operation of a typical converter circuit.	Perform experiments related to heterodyning.	D-2-28
C. Circuits 1. Oscillator a. Frequency b. Methods of Tuning		Install and test the Project 2 converter stage on the printed circuit board.	
2. R.F. a. Frequency b. Methods of Tuning c. Ganging with oscillator	be able to calculate oscillator and RF frequencies and resulting intermediate frequencies.		
3. Mixer a. Methods of Coupling		Participate in a review of converter circuits.	
b. Principles and Purposes of Heterodyning	be able to explain the principles and purposes of heterodyning.	Take a test related to converter circuits.	D-2-29

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
XV. Antennas	The student will:		
A. Definition	be able to identify and define the purposes and operation of various types of antennas.	Participate in class discussions related to antennas.	
B. Purpose			
C. Types 1. Hertz 2. Marconi 3. Special	be able to explain the meaning and purpose of impedance matching.		
D. Characteristic Impedance			
E. Transmitter/ Receiver Antenna Comparisons		Complete Project 2.	
		Test and align Project 2 as necessary.	D-2-30

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
XVI. Wave Propagation	The student will:		
A. Wave Origin 1. Oscillator 2. Modulator	be able to associate the oscillator and transmitter.	Participate in class discussions related to wave propagation.	
	be able to explain the purpose and operation of modulators.		
B. Power			
C. Wavelength/ Frequency	be able to associate and calculate wavelength and frequency.		
D. Frequency Spectrum			
E. Methods of Wave Travel	be able to explain the various methods of wave travel for various types of transmission.	Participate in a review of wave propagation.	
		Take a test related to wave propagation.	D-2-31

III. COURSE CONTENT - OBJECTIVE - ACTIVITY - EVALUATION SEQUENCE: Electronics II

CONTENT TOPICS	SPECIFIC PROGRAM OBJECTIVES	STUDENT ACTIVITIES	ASSESSMENT PROCESS
XVII. Consumer Knowledge A. Trouble-Shooting 1. Schematics 2. Electrical Specifications B. Applications for Personal Use	The student will: be able to identify components and circuits on a schematic. be able to measure and interpret various values in a circuit using a schematic. be able to intelligently select and purchase electronic components and devices	Participate in class discussions related to the importance of consumer knowledge when purchasing various pieces of electronic equipment having typical amplifier-receiver specifications.	

EXAMINATIONS

Catonsville Community College
Catonsville, Maryland 21228

Articulation Credit Examination
for ELE-101 Credit

PART I - Multiple Choice. Place correct letter in space provided on answer sheet.

1. A resistor with color bands arranged in the following manner would represent:

A. 360K @ 10%
B. 36K @ 10%
C. 36K @ 5%
D. 350K @ 5%

2. Which of the following represents the greatest current?

A. 36 coulombs/minute
B. 20 coulombs/3 seconds
C. 0.33 coulombs/second
D. 10 coulombs/20 seconds

3. Convert 0.00052 Amps to milliamps.

A. .52
B. 5.2
C. 52
D. 520

4. 84×10^5 is equal to

A. 8.4K
B. 84K
C. 840K
D. 8.4M

5. Determine the direction of electron flow in the circuit at right.

A. Clockwise
B. Counterclockwise
C. No current is flowing

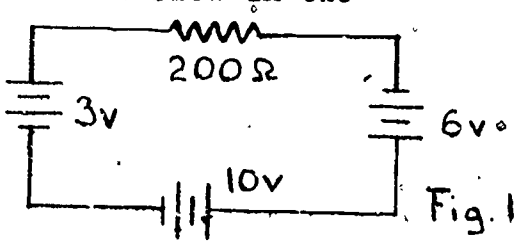


Fig. 1

6. In the circuit at right, I_T =

A. .36mA
B. .4A
C. 4mA
D. 36mA

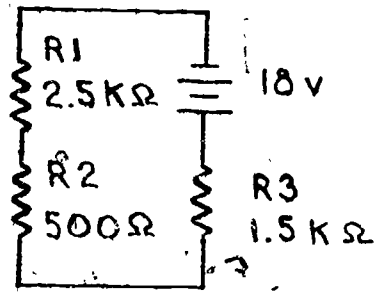


Fig. 2

7. In Figure 2, V_{R3} =

A. 2V
B. 6V
C. 10V
D. 18V

8. In Figure 2, P_{R2} =

A. 2mW
B. 4mW
C. 8mW
D. 72mW

9. In Figure #3, R_T = _____

$V_A = 10v$

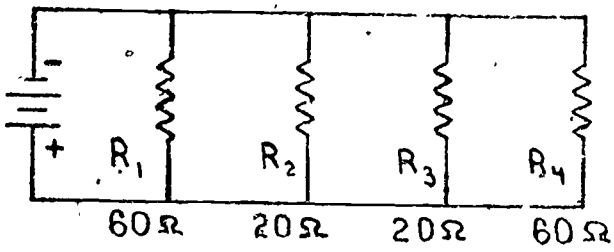


Fig. 3

A. 30
B. 7.5
C. 10
D. 100

10. In Figure #4, R_2 = _____

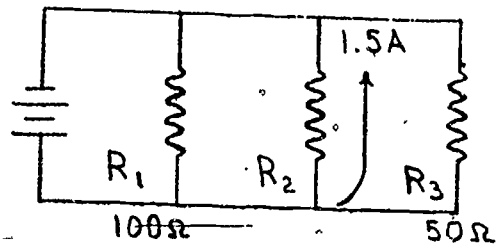


Fig. 4

A. 1.25
B. 12.5
C. 13.5
D. 125
E. 1.35

11. In Figure #5, R_T = _____

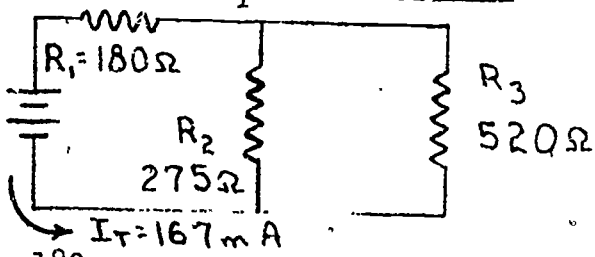


Fig. 5

A. 180
B. 243
C. 360
D. 975

12. The voltage applied in Figure #3 is _____V.

A. 2.2V
B. 5V
C. 50V
D. 60V

13. P_{R2} in Figure 3 is _____mV.

A. 1.73
B. 3.27
C. 10
D. 32.

14. A 5 ohm and 10 ohm resistor in series will dissipate

A. equal power
B. different values of power

15. A 150W light bulb is in parallel with a 60W bulb

A. The 150W bulb draws more current
B. The 60W bulb draws more current
C. The two bulbs draw equal current

16. When using an ohmmeter, never use

A. it in series
B. it to measure capacitors
C. It in an energized circuit
D. all of the above

17. A voltmeter is used in parallel because it has a

A. low input resistance
B. high input resistance
C. low sensitivity
D. red and black leads

18. A milliammeter is always placed in series with the circuit because of:

A. low resistance
B. high resistance

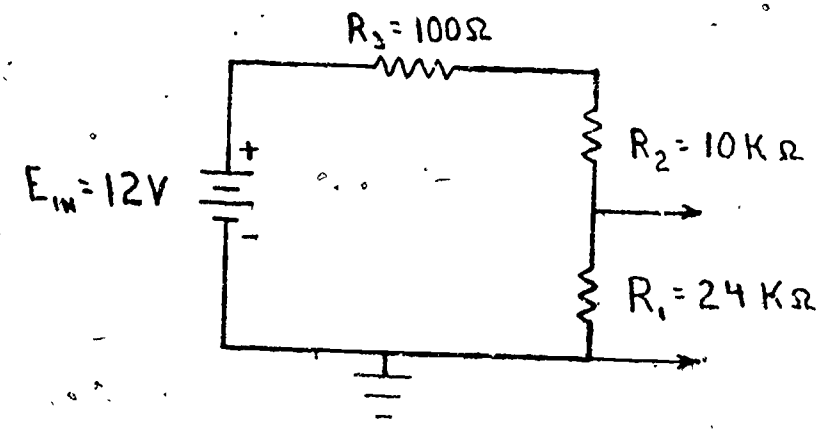
19. Ohmmeter measurements should be made with:

A. the circuit in operation
B. the circuit not in operation
C. high resistance ranges only
D. none of the above

20. A standby switch on a solid state DC power supply is used primarily for:

A. warmup of DC supply
B. circuit protection from initial circuit adjustments
C. placement of V_{OM} in circuit for measurements
D. both A and C above

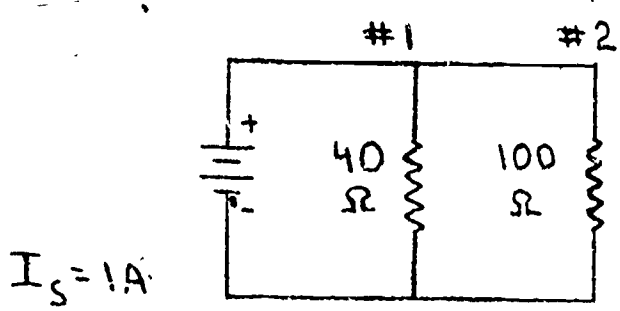
21. Determine the output voltage by the voltage divider rule.



V_{R1} = _____

A. .304 V
B. 3.04 V
C. 2.15 V
D. .215 V
E. none of these

22. Solve each branch current by using the current divider rule.



I_1 = _____

Calculate current in branch #1 (40 ohm resistor) using current divider equation.

I_1 = _____

A. .725 A
B. .0725 A
C. .29 A
D. .029 A
E. none of these

23. What would the voltmeter read in Figure 6?

A. 15 V
B. 30 V
C. 75 V
D. 225 V

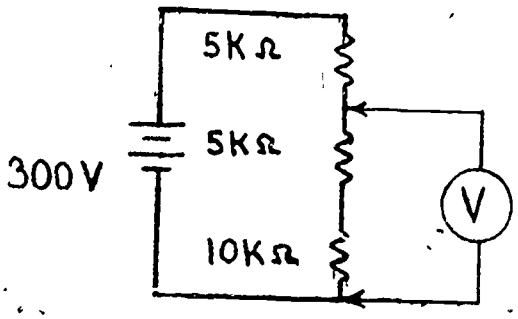
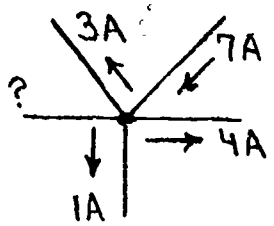


Fig. 6

24. The unknown current flow at the junction at the right would be

A. 0
B. 1A into junction
C. 1A out of junction
D. 15A out of junction



25. The material separating the two plates of a capacitor is called a/an

A. inductor
B. farad
C. coulomb
D. dielectric

26. Capacitance causes 90° lag in

A. voltage
B. current
C. ohms

27. In Figure 7, V_c would reach 6 V in

A. one time constant
B. two time constants
C. five time constants

28. In Figure 7, the current would be _____ in 60m Seconds:

A. .28mA
B. .74mA
C. 1.26mA
D. 2mA

29. V_R = _____ in one second

A. 0
B. .6V
C. 1.8V
D. 6V

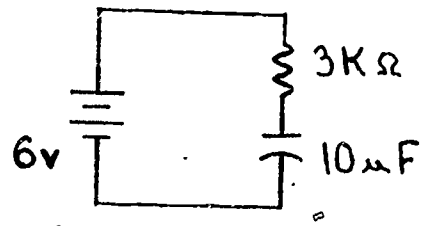


Fig. 7

30. Total capacitance and inductance respectively in Figure 8 is _____.

A. 2 f and 12H
B. 3 f and 16H
C. 9 f and 16H
D. 12 f and 12H

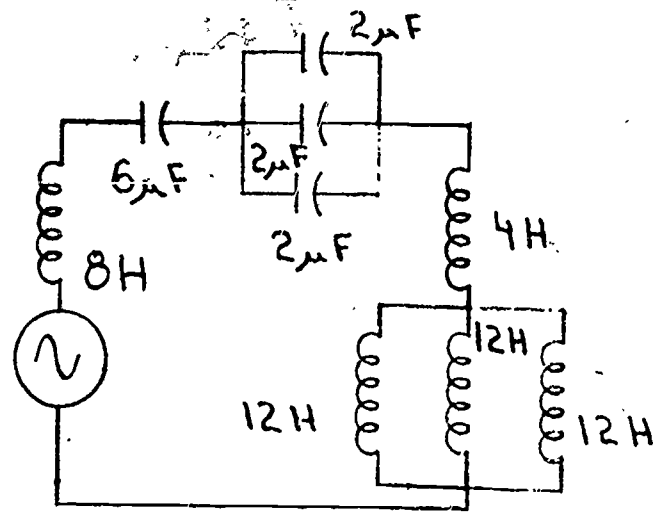


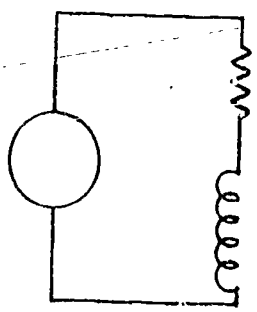
Fig. 8

31. Inductance is the property of a circuit to

A. oppose a change in current flow
B. oppose voltage increases
C. retart voltage by 90° (ideally)

32. An increase in frequency will cause a/an _____ in the circuit at right.

A. decrease in inductance
B. increase in inductance
C. decrease in inductive reactance
D. increase in inductive reactance



33. A 40 uF and 10 uF capacitor are in series. Which will drop the greatest voltage?

A. the 40 uF
B. the 10 uF
C. both will drop the same voltage

34. The period of a sinewave is .0056 seconds. The frequency is _____ Hz.

A. 17.8
B. 56
C. 120
D. 178

35. A circuit that would cause a phase shift of +45° would contain

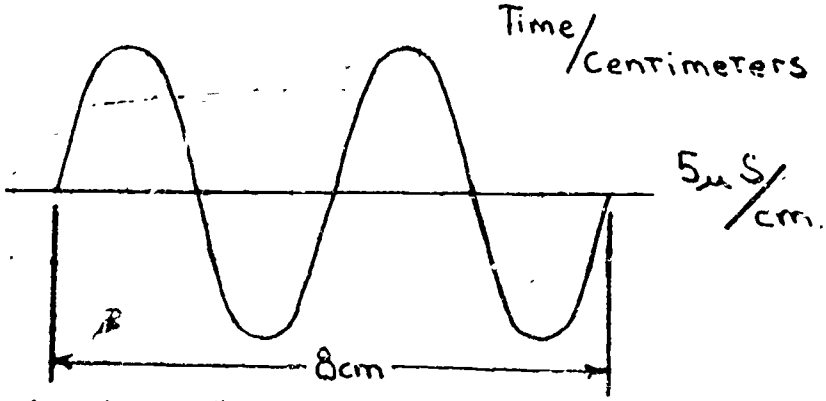
A. R and L
B. R and C
C. L and C
D. all of the above

36. If a VTVM reads 36 Volts RMS the oscilloscope presentation would be _____ volts p-p.

A. 100
B. 36
C. 18
D. 12.5

37. The frequency of the signal displayed at the right is

A. 5KHz
B. 8KHz
C. 25KHz
D. 50KHz



38. Total impedance in Figure #9 is approximately _____ ohms.

A. 10
B. 1K
C. 2K
D. 3K

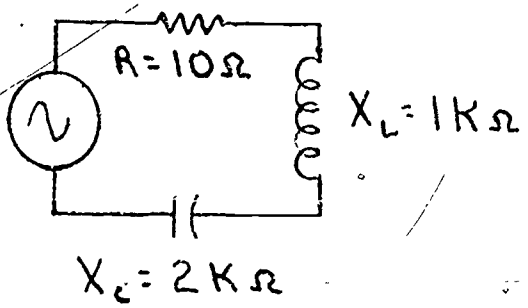


Fig. 9

39. The vector representing E_c is plotted

A. horizontal to the right
B. horizontal to the left
C. vertically up
D. vertically down
E. diagonally to the lower right

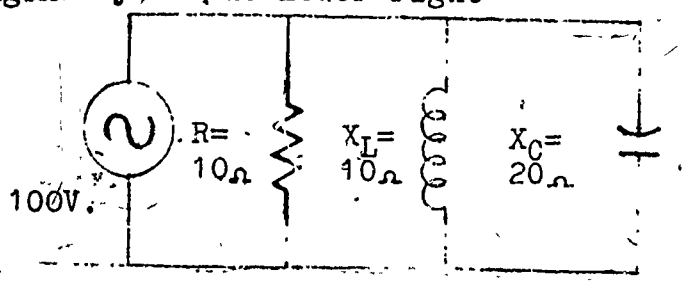
40. The angle of lag ( ) in a circuit is the phase shift between

A. R and X_L
B. R and X_c
C. E_R and E_L
D. E_T and I_T

41. In Figure #10 at right, the vector for total current (I_T) is plotted

A. horizontal to the right
B. vertical up
C. vertical down
D. diagonally to the upper right
E. diagonally to the lower right

FIGURE #10



42. The principle advantage of a vacuum tube voltmeter (VTVM) over a VOM is its

A. sensitivity
B. portability
C. nearly zero impedance
D. impedance range

43. The oscilloscope presentation of a sine wave would have a voltage indicated in

A. effective
B. average
C. peak
D. peak to peak

44. The oscilloscope function that controls the sweep rate of the beam is the
A. intensity
B. vertical sensitivity
C. stability
D. time/cm

45. To properly view the voltage waveform in Figure 11, the oscilloscope should be:

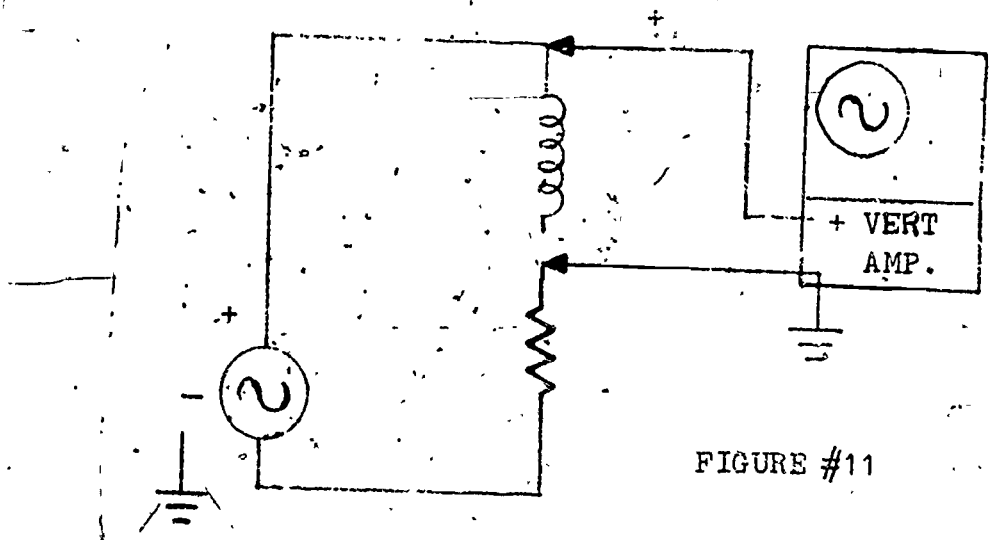
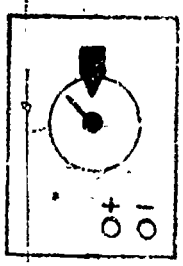


FIGURE #11

A. warmed up
B. use ground lifting adapter
C. use non-polarized inductor
D. cannot be measured

46. What is the lowest load impedance that could be connected to the AC generator in Figure #12 and still operate within specifications?



OUTPUT Z FIGURE #12

A. 1000
B. 100
C. 50
D. none of the above

47. What is the main reason for checking the VOM and VTVM instruments for zero sdjustment?

A. to check calibration
B. to check to see if internal battery is functional
C. to check to see if internal circuitry is operating
D. to check lead continuity

48. The instantaneous value of voltage from a fundamental generator is _____ when E_{max} = 6V and the cutting angle is 55°.

A. 3.67V
B. 4.9 V
C. 6 V
D. 9.67 V

49. According to Faraday's Law, the magnitude of induced emf and is

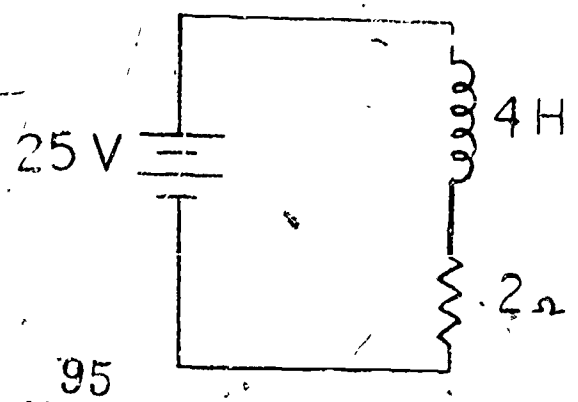
A. directly proportional to rate of current change
B. inversely proportional to the rate of current change
C. directly proportional to induced voltage
D. inversely proportional to magnetic field strength

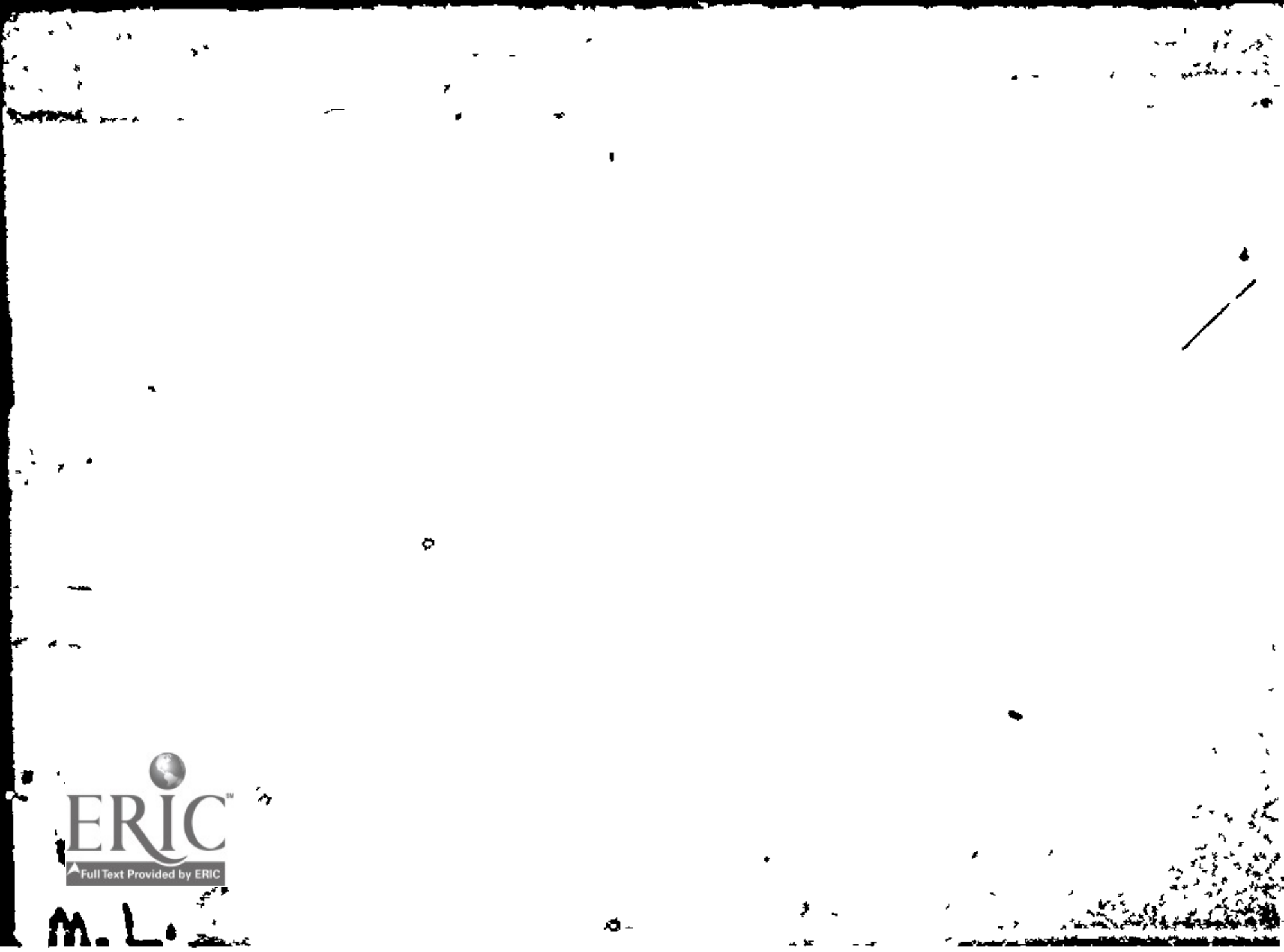
50. The Q of a coil can be increased by increasing

A. frequency
B. current
C. applied voltage
D. resistance

51. In the circuit at right V_L is _____ in 2 seconds

A. 0V
B. 9.25V
C. 15.75V
D. 25V



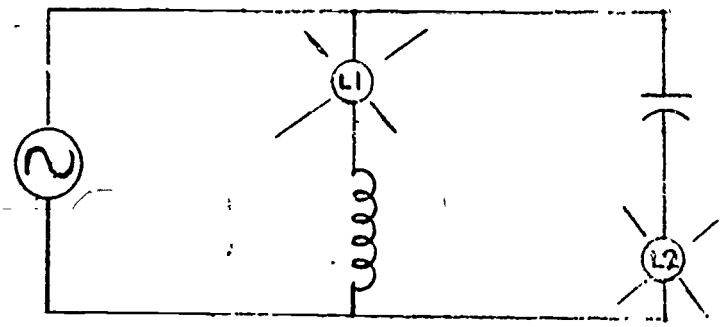


52. I_L at 6 seconds is _____amps.

A. 4.6A
B. 7.3
C. 11.9
D. 16.5

53. As the frequency increases, what happens to the brightness of lamps L1 and L2?

A. L1 increase L2 increases
B. L1 decreases L2 decreases
C. L1 increases L2 decreases
D. L1 decreases L2 increases



54. In a pure inductive circuit Z is plotted

A. Horizontal to the right
B. Vertically up
C. Vertically down
D. Diagonally to upper right
E. Diagonally to lower right

55. Vector I_C is plotted _____ in a parallel circuit

A. Horizontal to the right
B. Vertically up
C. Vertically down
D. Diagonally to upper right
E. Diagonally to the lower right

56. The oscilloscope control that allows accurate voltage measurement is in the

A. Power supply
B. Sweep generator
C. Horizontal amplifier
D. Vertical amplifier

57. The units of reactive power is the _____

A. watt
B. volt-ampere
C. var

58. In the power triangle, the hypotenuse relates to

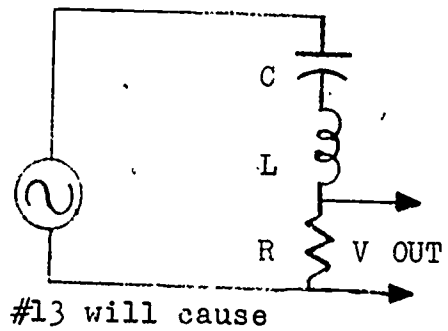
A. apparent power
B. true power
C. reactive power

59. The resonant frequency of a series resonant circuit can be increased by

A. increasing L
B. increasing C
C. increasing R
D. none of the above

60. A decrease in R of Figure #13 will cause circuit current to

A. increase
B. decrease
C. remain constant



RESONANT CIRCUIT

FIGURE #13

61. A decrease in R of Figure #13 will cause circuit bandwidth to

A. increase
B. decrease
C. remain constant

62. A decrease in R of Figure #13 will cause the phase angle (θ) to

A. increase
B. decrease
C. remain constant

63. Which of the following is true in <u>both</u> series and parallel resonant circuit?

A. Z_T is minimum at resonance

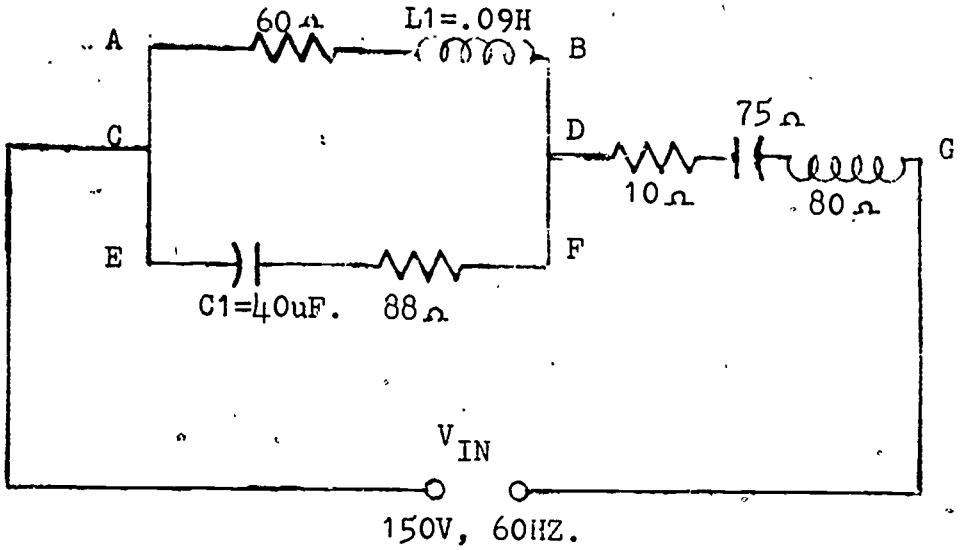
B. I_{line} is a minimum at resonance

C. θ is large at resonance

D. X_L is equal to X_C at resonance

E. Reactance total maximum at resonance

PART II - Multiple Choice



1. X_{L_1} = _____ ohms

   A. 10
   B. 22
   C. 34
   D. 66

2. X_{C_1} = _____ ohms

   A. 44
   B. 66
   C. 88
   D. 100

3. Z_{AB} = _____ ohms

   A. 34 - j60
   B. 34 + j60
   C. 60 - j34
   D. 60 + j34

4. Z_{AB} = _____ ohms

   A. 34 ∠+29°
   B. 60 ∠+29°
   C. 69 ∠+29°
   D. 69 ∠-29°

5. Z_{EF} = _____ ohms

   A. 88 - j40
   B. 88 - j66
   C. 110 - j88
   D. 110 + j88

6. Z_{EF} = _____ ohms

   A. 110 ∠-37°
   B. 37 ∠-110°
   C. 37 ∠-88°
   D. 88 ∠-37°

7. Z_{DG} = _____ ohms

   A. 10 + j5
   B. 5 + j10
   C. 10 - j5
   D. 5 - j10

8. Z_{DG} = _____ ohms

   A. 5 ∠26.6°
   B. 7.5 ∠26.6°
   C. 9.5 ∠26.6°
   D. 11.2 ∠26.6°

If $Z_{CD} = 50 \angle 4^\circ$

9. Z_{CD} also equals _____ohms

A. 49.6 - j3.7
B. 37 + j49.6
C. 49.6 + j3.7
D. 37 - j49.6

10. Z_T = _____ohms

A. $50.3 \angle 4^\circ$
B. $60.5 \angle 7.6^\circ$
C. $76 \angle 50^\circ$
D. $60.5 \angle -7.6^\circ$

11. Power factor =

A. .01
B. .02
C. .64
D. .99

12. True power = _____watts

A. 2.48W
B. 37.2W
C. 368W
D. 372W

Catonsville Community College
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Articulation Credit Examination
for ELE-102 Credit

PART I - Multiple Choice. Directions: Place correct letter on answer sheet provided.

1. At series resonance
   a. $X_L = Z$
   b. $X_C = Z$
   c. $R = Z$
   d. none of the above

2. At parallel resonance the line current (I_t) is
   a. maximum value
   b. minimum value
   c. 50% of maximum value
   d. .707 of maximum value

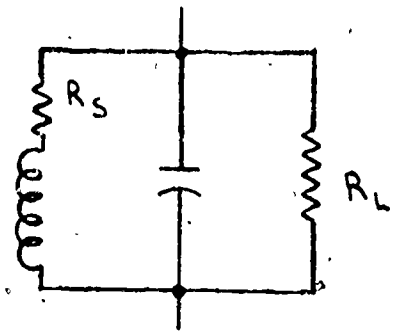
3. An increase in the value of C at series resonance will do what to resonant frequency?
   a. increase f_r
   b. decrease f_r
   c. no effect on f_r

4. An increase in the value of R at series resonance will do what to resonant frequency?
   a. increase f_r
   b. decrease f_r
   c. no effect on f_r

5. Impedance of a series resonant circuit at resonance is:
   a. maximum
   b. minimum
   c. .707 of maximum

6. In Figure 1, increasing R_L causes what effect to circuit bandwidth?

a. increase
b. decrease
c. remains constant



7. In Figure 1, increasing R_s causes what effect to circuit Q?
   a. increase
   b. decrease
   c. remains constant

8. At parallel resonance a tank circuit acts
   a. resistive
   b. capacitive reactive
   c. inductive reactive
   d. all of the above

9. Which of the following is not an application of a transformer?

   a. match impedances
   b. rectify voltages
   c. step up voltage
   d. step down current
   e. act as a coupling device

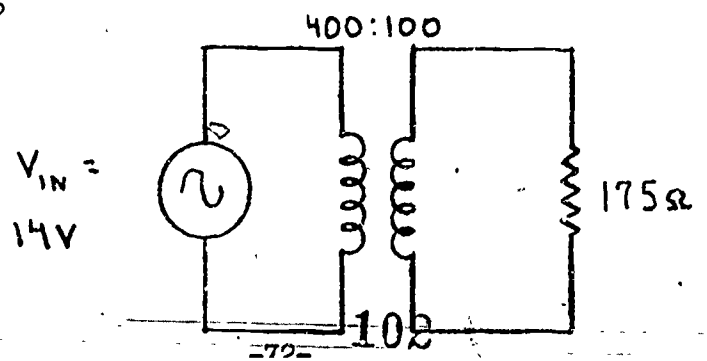
10. The purpose of including an iron core in a transformer is to increase

    a. reluctance
    b. weight
    c. permeability
    d. turns ratio

QUESTIONS 11 through 14 refer to Figure 2.

11. Determine secondary voltage. V_s = _____ v

    a. 3.5
    b. 7
    c. 14
    d. 56



12. Determine secondary current. I_s = _____ mA

a. 14
b. 20
c. 80
d. 320

13. Determine primary current. I_p = _____ mA

a. 5
b. 20
c. 80
d. 320

14. Determine primary impedance. Z_p = _____

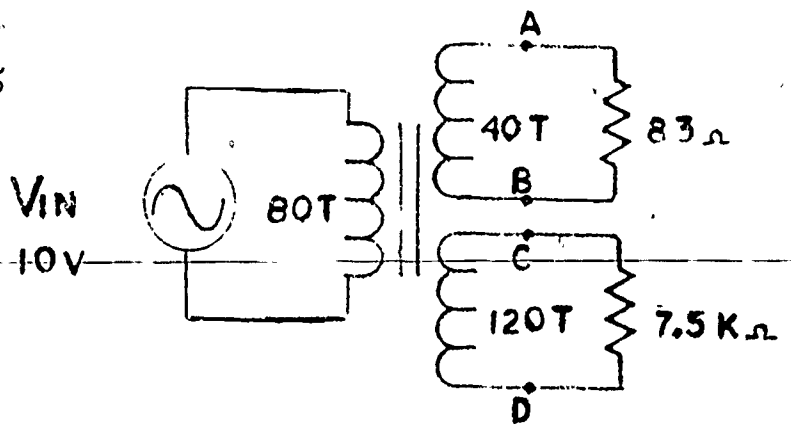
a. 700
b. 2.8K
c. 3.5K
d. 5.6K

15. A step up transformer implies that _____ is stepped up.

a. resistance
b. current
c. voltage
d. power

QUESTIONS 16 THROUGH 18 REFER TO FIGURE 3.

16. The transformer turns ratio for secondary A - B is:
a. 1 to 2
b. 1.5 to 1
c. 2 to 1
d. 1 to 1.5



17. Primary current in the circuit is _____ ma.

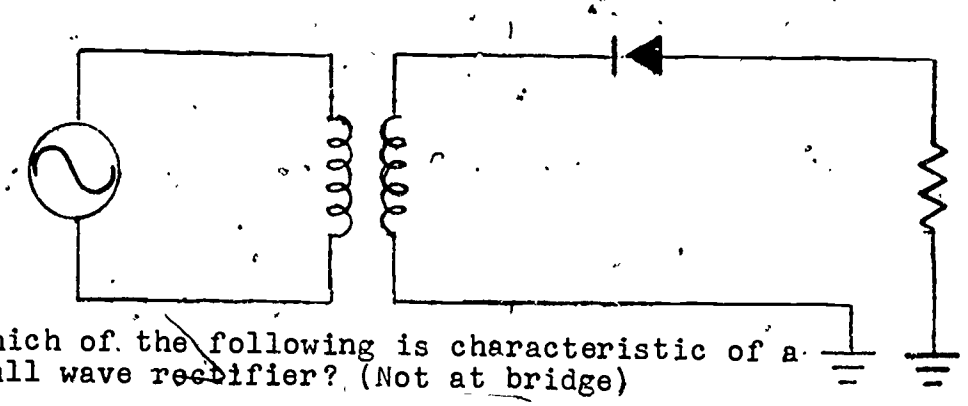
a. 25
b. 33
c. 50
d. 75
e. 750

18. If points "B" and "C" are shorted together, the secondary voltage from points "A" to "D" would be _____.

a. 5
b. 10
c. 15
d. 20
e. none of the above

19. The rectifier in Figure 4 gives an output that is _____ with respect to ground.

a. positive
b. negative
c. zero



20. Which of the following is characteristic of a full wave rectifier? (Not at bridge)

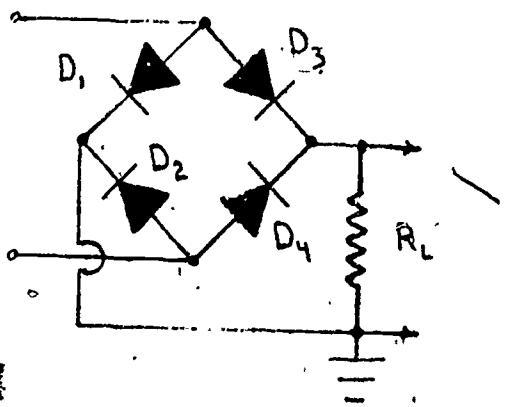
a. 120 HZ input frequency
b. 4 diode rectifiers
c. negative output voltage
d. tapped secondary transformer

21. What advantage does a bridge rectifier offer over a conventional full wave?

a. (+) or (-) output
b. no transformer
c. 2 diodes
d. low ripple frequency

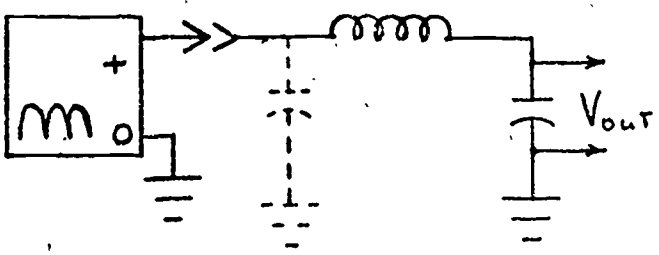
22. Which two diodes must be revised in Figure 5 in order to obtain the correct positive output voltage?

a. D1 and D2
b. D1 and D3
c. D2 and D3
d. D2 and D4

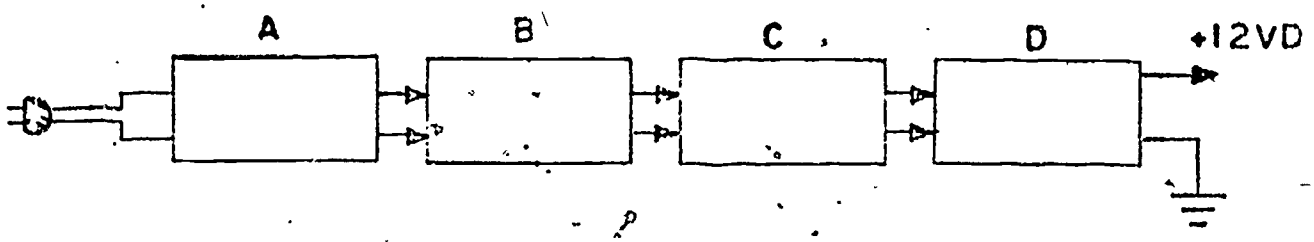


23. In Figure 6, the addition of a 10 ufd capacitor from point "x" to ground will have what effect on Vout?

a. no effect
b. vout will fall to zero
c. vout will increase slightly
d. vout will decrease slightly

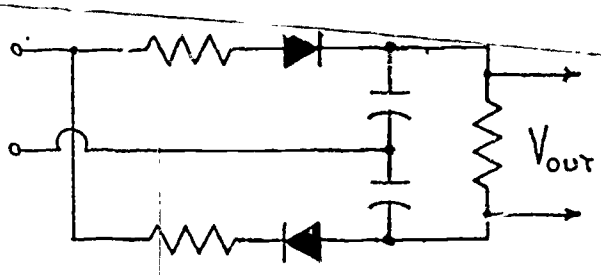


24. A good low voltage power supply has 4 major components/circuits. They are: (4 points)



25. The voltage doubler of Figure 7 is a _____ doubler.

a. full wave
b. half wave
c. it is not a doubler

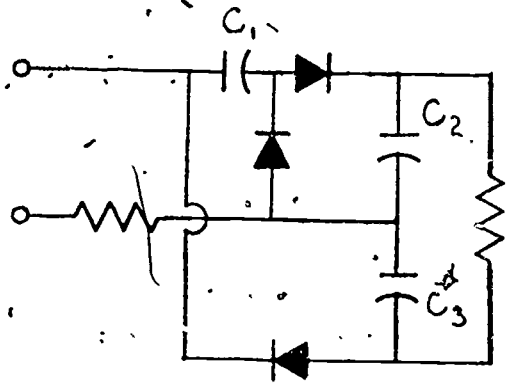


26. Vout of a voltage doubler is approximately equal to _____.

a. 2 · Vavg
b. 2 · Vrms
c. 2 · Vpk
d. 2 · Vpk - Vpk

27. The circuit in Figure 8 has what approximate voltage on C2?

a. Vin
b. 2 Vin
c. 3 Vin



Questions 28 through 35 refer to Figure 9.

28. The circuit is a _____ regulator.

a. series
b. shunt
c. impedance
d. current

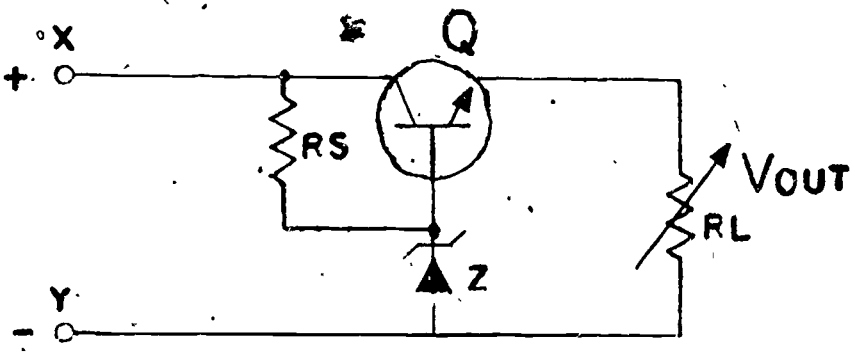


FIG. 9

29. During normal operation
a. point X = negative, Y = positive
b. point X = positive, Y = negative
c. either a or b

30. Which component is referred to as the pass element?

a. Q
b. R
c. R_L
d. Z

31. Which is true about Vout?

a. V_{in}
b. $V_{in} - V_Z + V_{BE}$
c. $V_{CE} - V_Z$
d. $V_Z - V_{RL}$

32. Which of the following is true about Figure 9?

a. $I_{RS} = I_C + I_B$

b. $I_B = I_Z + I_{RL}$

c. $I_B = I_{RS} - I_Z$

d. $I_{in} = I_E + I_{RL}$

33. Which is true about Figure 9? It provides

a. a constant voltage for a varying current
b. a constant current for a varying voltage
c. zener current equals load current
d. constant load power at the load

34. Which function is <u>not</u> performed by Figure 9?

a. it reduces ripple voltage
b. it eliminates the need for a rectifier
c. allows for load variations
d. allows input voltage variations

35. In Figure 9 (if B = 90, Ig = 8mA, I_{R_S} = 9mA) I_{R_L} = _____ mA.

a. 0.5
b. 90
c. 107
d. 80

36. Which circuit in Figure 10 is referred to as collector feedback biasing?

37. Which circuit in Figure 10 is called base current biasing?

38. In Figure 10, across which resistor would an emitter bypass capacitor be used?

a. R_2

b. R_5

c. R_9

d. R_{11}

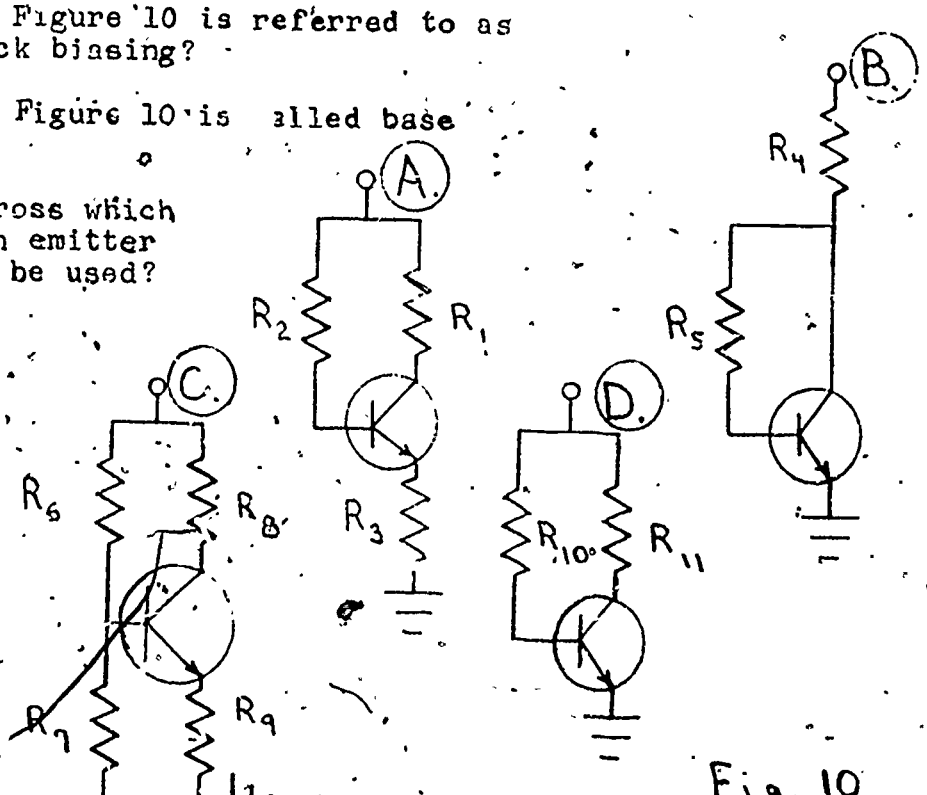


Fig. 10

39. In Figure 10, which resistor could be completely removed without eliminating collector current? (opened)

a. R_3

b. R_5

c. R_7

d. R_{10}

40. Which circuit in Figure 10 is not employing feedback for stability?

41. When feedback is used for stability in an amplifier, it is called

a. regenerative
b. negative
c. positive
d. repulsive

42. Which is correct about TGIR? Av

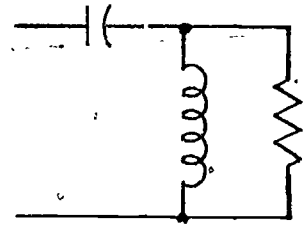
a. $\frac{R_{out}}{Z_{out}}$

b. $\frac{R_{in}}{Z_{in}}$

c. $\frac{R_{in}}{R_{out}}$

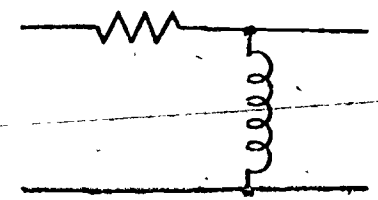
d. $\frac{Z_{out}}{Z_{in}}$

43. The Filter in Figure 11 is a
a. type high pass
b. type low pass
c. L type high pass
d. L type low pass



44. The filter in Figure 12 is a

a. high pass
b. low pass
c. band pass
d. band stop

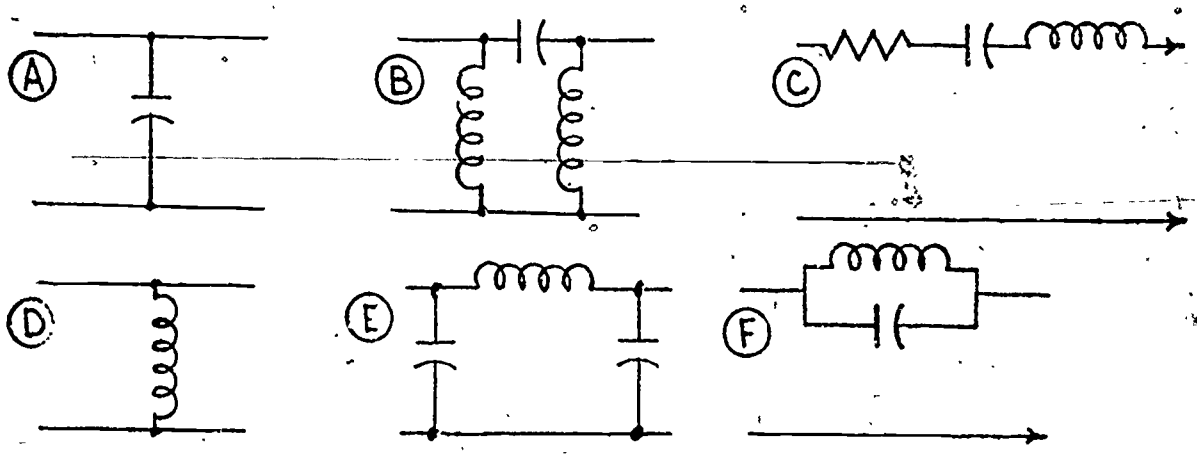


Matching Questions 45 through 47.

45. Low pass type filter

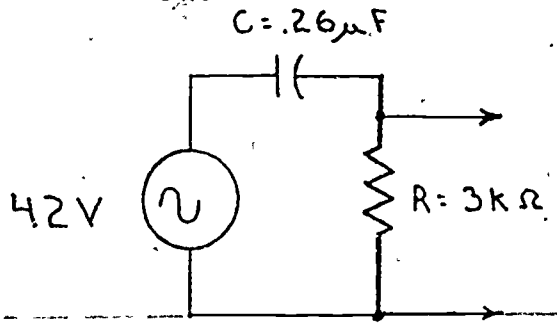
46. Band stop filter

47. High pass filter



48. If the cutoff frequency of Figure 13 is 227 H_Z, what is V_{out}?

a. 6.3 V
b. 29.4 V
c. 54.6 V
d. 132 V



Use the low voltage power supply(Figure 14) for questions 49 through 55.

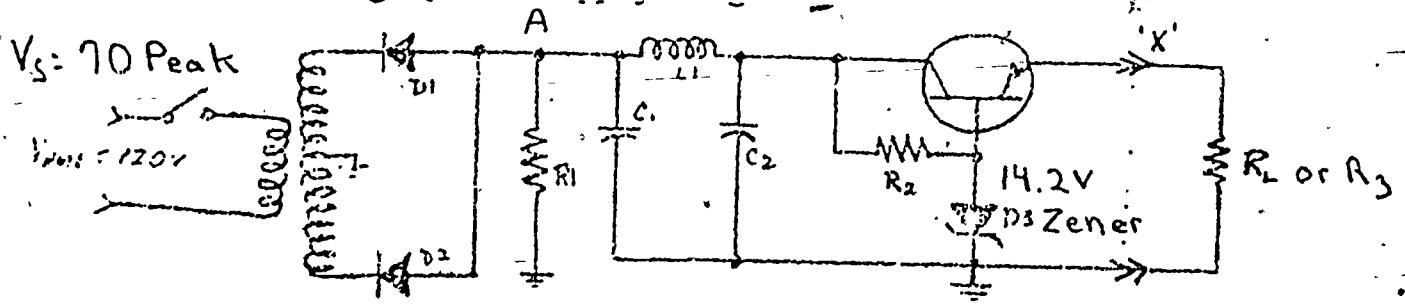


Fig. 14

49. The voltage at point A with respect to ground is
a. positive DC
b. negative DC
c. AC

50. The voltage at point A would be approximately
    a. +17, -17 (AC)
    b. +34, -34 (AC)
    c. 21.5
    d. 34

51. C1, L1, C2 comprises a _____filter.

    a. high pass
    b. low pass
    c. band pass
    d. band reject

52. The purpose of R1 is to

    a. limit load current
    b. serve as a voltage regulator
    c. drain capacitor charge when S1 is open
    d. protect Q1.

53. D1, D2 are acting as a _____rectifier.

    a. full wave
    b. half wave
    c. quarter wave
    d. bridge

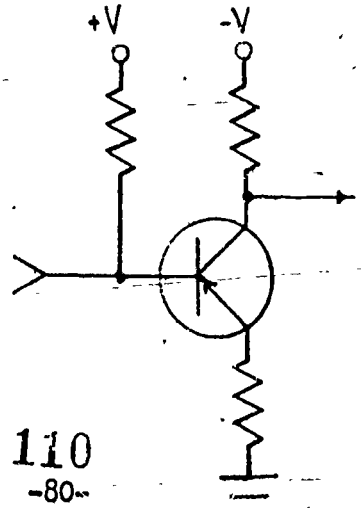
54. V_{out} (point X) is _____volts.

    a. +14.9
    b. -14.9
    c. +13.5
    d. -13.5

55. Inductor L1 could be replaced with a resistor with minimal output voltage change.

    a. true
    b. false

56. The circuit in Figure 15 is a _____amplifier.
    a. common emitter
    b. common base
    c. common collector



57. Which amplifier configuration does not have a current gain 1 ?

a. common emitter
b. common base
c. common collector

58. Which amplifier configuration has a 180° phase shift?

a. common emitter
b. common base
c. common collector

59. The lowest output impedance is obtained with a

a. common emitter
b. common base
c. common collector

60. Which of the following is the correct Shockley approximation?

a. $A \approx \frac{R_L}{R_i}$

b. $R_{in} \approx \frac{V_{in}}{i_{in}}$

c. $I_E \approx \frac{h_{1b}(.026)}{I_B}$

d. $h_{1b} \approx \frac{.026}{I_E}$

61. The voltage at which drain current stabilizes ($I_D = 0$) is the

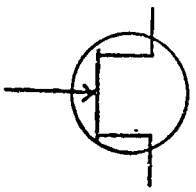
a. pinch off voltage
b. cutoff voltage
c. threshold voltage
d. breakdown voltage

62. Which is true about p-channel JFET biasing?

a. gate negative, drain positive
b. gate positive, drain positive
c. gate positive, drain negative
d. gate positive, drawin negative

63. The JFET depletion region contains
    a. majority carriers only
    b. minority carriers only
    c. both majority and minority carriers
    d. N type impurities

64. The schematic symbol in Figure 16 is representing a/an
    a. Unijunction transistor
    b. P channel JFET
    c. N channel JFET
    d. MOSFET



Questions 65 through 76 pertain to the circuits in Figure 17.

DIRECTIONS: ANSWER "T" FOR TRUE, "F" FOR FALSE.

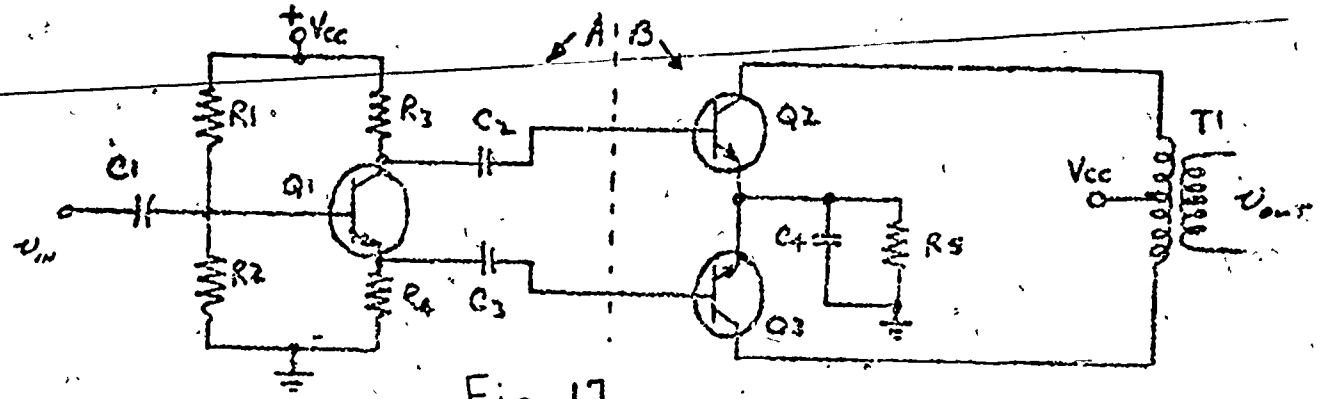


Fig. 17

65. Circuit A is a RF power amplifier.

66. Circuit B is a push pull power amplifier.

67. Circuit A could be replaced by a tapped secondary transformer.

68. The inputs to Q_2 and Q_3 must be identical in phase and amplitude.

69. This circuit configuration ususally provides high distortion.

70. T_1 usually feeds a crystal oscillator.

71. The circuit will function without C_4.

72. Q_1 should be a PNP transistor.

73. The input to Q_1 could be from a phase shift oscillator.

74. The collector supply for Q_2 and Q_3 must be (+).

75. An increase in the value of C_1 will improve LF response.

76. Q_3 is in backwards (collector and emitter reversed).

Questions 77 through 82 contains oscillator types. Match the name of each oscillator with the brief description.

_____	77.	two tapped capacitors	a. Armstrong
_____	78.	three RC networks	b. Phase shift
_____	79.	"tickler" coil	c. Colpitts
_____	80.	piezoelectric effect	d. Electron coupled
_____	81.	one tapped coil	e. Hartley
_____	82.	series tank capacitor	f. Ultra-Audion
			g. Clapp
			h. Crystal
			i. Wein bridge

83. A frequency multiplier is operated Class _____.

a. A
b. B
c. C
d. AB

84. A device that converts DC energy to AC energy is called a/an
a. crystal
b. motor
c. amplifier
d. oscillator

85. Oscillator instability is often caused by

a. buffer amplifiers
b. load variations
c. ambient temperature
d. humidity

86. The natural resonant frequency of a quartz crystal is dependent on
a. circuit voltage
b. circuit current
c. physical dimensions
d. amount of feedback

87. Crystal oscillators usually require an oven to
a. maintain a constant temperature
b. boil out moisture
c. maintain a constant capacitance
d. provide a constant voltage

88. The selectivity of a receiver is its ability to
a. reject audio frequencies
b. distinguish between adjacent channels
c. pass only audio frequencies
d. amplify weak signals

89. In amplitude modulation, as the intelligence frequency is increased the modulation percentage will
a. increase
b. decrease
c. remain constant
d. vary constantly

90. In amplitude modulation, as the amplitude of the intelligence is increased, the mod. percentage will

a. increase
b. decrease
c. remain constant
d. have no effect

91. If the modulation factor is .83, the percentage of modulation is

a. 17%
b. 83%
c. .17%
d. .83%

92. The signal that is modulated is called the _____ frequency.
a. local oscillator
b. intelligence
c. carrier
d. difference

93. An FM carrier is recognizable by its
a. constant amplitude
b. constant frequencey
c. varying amplitude

DIRECTIONS: Answer "T" for true, "F" for false for Questions 94 through 103
Refer to Figure 18.

AM Transmitter

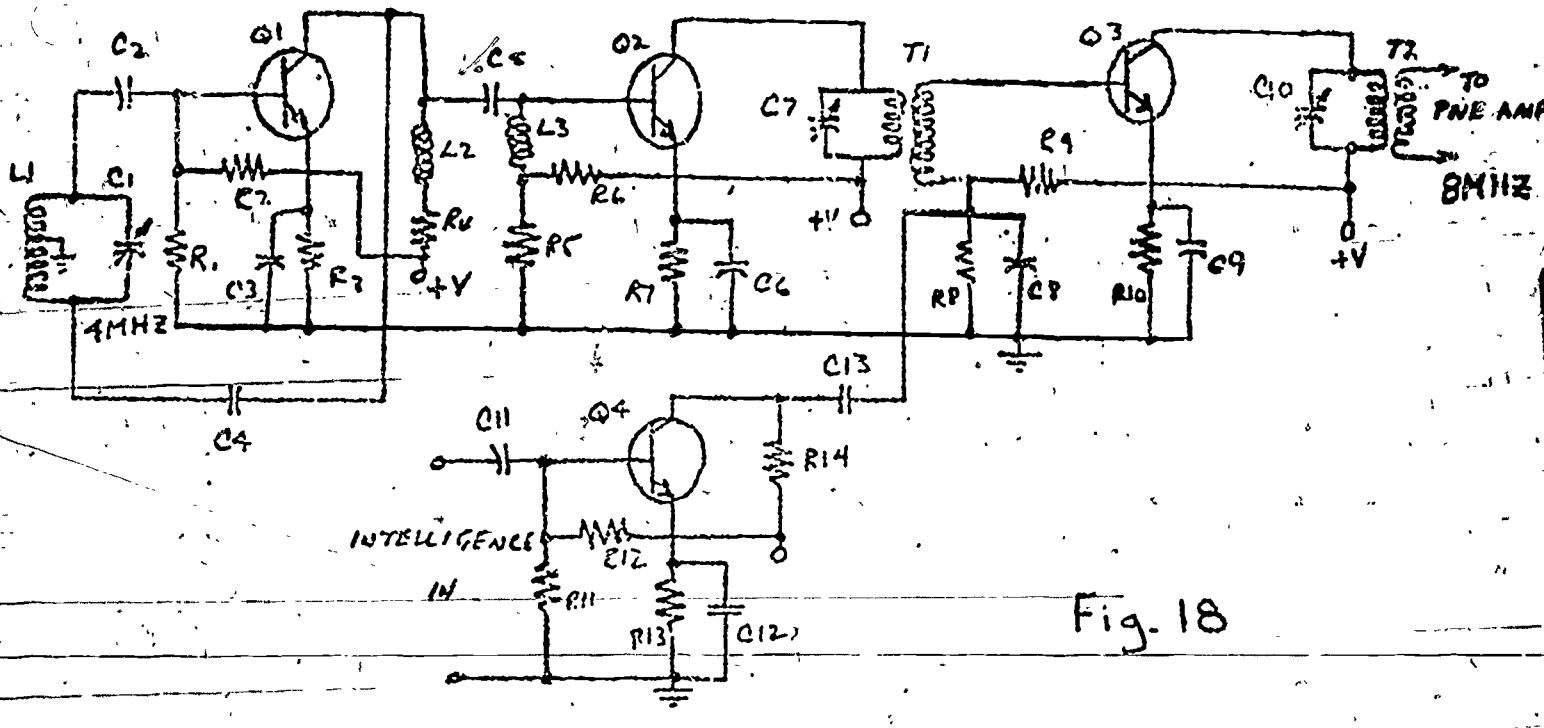


Fig. 18

94. The circuit containing Q1 is a pierce oscillator.

95. Circuit containing Q2 is a buffer amplifier.

96. The circuit containing Q3 is an audio amplifier.

97. The circuit containing Q4 is a single ended power amplifier.

98. The tank circuit containing C10-T2 is tuned to C1-L1's.

99. Ideally the X_L for L2 is zero ohms.

100. Ideally the X_C of C11 is zero ohms.

101. C9 is a coupling capacitor.

102. C6 shorts, the output frequency will drop to 4MHZ.

103. C5 increases in value, the output remains at 8MHZ.